Environmental Windows and the Endangered Species Act: Protecting Salmonids in the Pacific Northwest

By Charles Simenstad

Good morning. I don't think Doug asked me down or Tom asked me down to experience some filtered sunlight from the northwest. I think my role here is perhaps to present the worst case situation you could run into in terms of dredging, and that is dealing with anadromous salmonids that are threatened or endangered under the Endangered Species Act, in a region that has perpetual need, particularly in ports for dredging, the Pacific Northwest.

And just a few introductory comments. The picture up there is a turn of the century picture of dredging in the Elliot Bay where Seattle is located.

And I want to reinforce, not only is this a societal process as Jerry mentioned, but there's a legacy that we and you all in particular are facing that comes home to roost with the Endangered Species Act, because we're looking at trying to recover resources. And people quite often look backwards in time at all the sources of stressors that were responsible in one way or another for the decline and demise of those resources.

And so they're not necessarily looking at the state of the science, the state of the technology, the state of engineering, and how we move forward and recover those resources. So there is a definite need for education and information above and beyond science and engineering.

And the other is, I'm going to ask you to challenge yourselves a little bit because I'm going to ask you to think for the next few minutes about representing that resource; being the scientist, in particular the agency scientist at that table somewhere in step four or something like that. And just sit back for a few minutes and think about if you were the representative of this resource, how would you treat this process, and what would be your responsibility? So this is not only the other person's shoes, but the other person's hat. But I also want to make the strong point that this is from the perspective of a scientist.

The School of Aquatic and Fishery Sciences actually started as the College of Fisheries back at the turn of the century, the same time this activity was going on. And the faculty member at the University of Washington when it started -- well, Trevor Kincaid actually started the Department of Zoology and the medical school; a few other things.

But when he was serving as Dean of the College of Fisheries, he attended a conference back in the days when salmon were heavily exploited. And this was sort of a comprehensive evaluation, a conference about the status of salmon. And there were the fishing companies and the canners and the wholesalers and the retailers. And everybody went around the room and introduced themselves. And it finally came down to Trevor

Kincaid, and he was looking out in this audience of folks that viewed the salmon as a product. And he said, "well, I'm Trevor Kincaid, Dean of the College of Fisheries. I guess I represent the fish."

And that's the important thing for any scientist at that table. They represent information. They don't necessarily and shouldn't be representing their agencies and their agency politics, shouldn't represent necessarily public opinion. They should represent the resource.

Now again I'm talking about sort of the worst case situation. It's worst case because in the Pacific Northwest more than probably any place in the world, except maybe some other regions in the Pacific realm, salmonids -- and I'm technically speaking here of salmon and anadromous trout and char, an extremely diverse family in terms of their passage through the area that you dredge. Kind of a freshwater estuarine and nearshore marine environment are the habitats for those fish and quite often extended habitat.

And they're also at the time in their life history when they are very vulnerable juveniles. They're physiologically sensitive. They're very susceptible to predation, and they're often confined to very highly ecological niches. And because of that, they're behaviorally constrained. There are certain habitats and conditions that they don't have a lot of latitude and flexibility to avoid, either behaviorally or physically. So, their decision process isn't very variable. And we also know that there are some very well documented sublethal responses to estuarine contaminants.

The second time they come around as adults is much less an issue. They're much more focused in time and space on the obvious, on reproduction. There is some issue about delay of migrating salmon. But again their motivation is much stronger behaviorally.

I just wanted to sort of give you an impression. And again I'm going to be talking the rest of the time pretty much about this juvenile phase.

A tidal floodplain with the watershed up here to the right and the ocean out here. And I just want to make the point that this migration through the tidal floodplain and the estuarine zone to the ocean is a very punctuated migration. A lot of salmon move down even during the winter period right after they've emerged from gravel and occupy this tidal freshwater floodplain. And some of them actually even turn around and go back upstream for extended periods, over a year or two.

Those that are actually in a migratory mode will eventually move down into the brackish zone, the lower salinity zone. And those species that particularly need to adapt for some time to salt water will spend anything from weeks to months in this brackish oligohaline zone if the habitat is available to them.

And then eventually those will move down into the euryhaline zones, some of these zones, the area where you probably most often encounter dredging. This is quite often where the ports lie and the channels lie, and then out into the euryhaline and the oceanic areas.

Also in places like the inland sea of the Puget Sound where you'll get juvenile salmon moving back who are migrating, which will eventually come in to these areas and move back out again on their transit out to the North Pacific Ocean.

So, it's really a landscape. Some people call it an ecoscape that salmon will spend a whole variety of periods in. And in some cases there are some definite ecological bottlenecks such as this position of the brackish of the haline zone where they must adapt to increasing salt water.

The other is that there's a whole sequence of life history trajectories of these fish. So you have species like pink salmon, which move very rapidly down into estuaries with no freshwater rearing. Their estuarine rearing will be on the order of a few weeks, and they'll move rapidly out to the ocean. And they have very fixed periods, two years in the ocean.

Chum salmon are sort of the same thing in terms of their trajectory, but they have more extended estuarine rearing. They're probably the second most estuarine-dependent salmon in our region.

Coho salmon in most cases are rearing in sort of this trajectory in freshwater. And they move out with very little estuarine rearing.

Sockeye is pretty much the same thing. And here we have Chinook. And if you add up all these trajectories and all the periods they spend in the ocean, there's about 36 odd life history trajectories. And each of those potentially is characteristic of different populations.

And the ones that are of most concern to our discussion today are those that actually spend very little time in freshwater and will come down and spend sometimes three months in estuaries before moving out to the ocean. And again this is quite variable, but the variability is the key.

Now, this might be sort of what you would consider to be again the worst case situation in trying to protect the resource that's passing through an estuary. I'm using this as an example, and again it's an extreme example. This is the historic structure of juvenile salmon passing through the Columbia River estuary. This isn't the way it is now, and I won't go into the reasons for that.

But the point I do want to make is this diversity is what many of us feel has been lost in Pacific salmon populations. And it's this diversity to a large degree that has

accounted for and potentially now is not supporting the resilience in the population to environmental variability in the ocean.

But what I want to point out here is the most susceptible life history types, which are these fish that are very small. These are fry, several kinds that are less than 50 millimeters. These fish are only this big. Fingerlings to a lesser extent.

And these Yearlings, these large fish that spend a large amount of time in freshwater. Notice that these Yearlings are really sort of in this February to June period.

Whereas these what we call ocean-type fish, that spend much time in freshwater are spread throughout the January to November period. This is just one year. So, if you took one population, these are all the life history types, and the timing through the estuary, so where is your window?

Now this gets complicated in the Pacific Northwest with listing the number of species. The Columbia River system has 13 stocks that are listed as threatened and endangered. And two years ago two stocks in the Puget Sound, the Summer Chum, and then the Puget Sound Chinook were both listed.

And all of a sudden that ups the ante. That ups the risk factor. The allowable take now becomes probably not as bad as turtles but, you know, becomes tens to hundreds.

And there's an interesting aspect in that you can treat inner estuaries just like that picture I just showed, as having some unique stock characteristics that you can work around.

You get into places like the Puget Sound where you have complexes in estuaries. All of a sudden you have all these populations mixing in a system. So, your estuary all of a sudden isn't going to have just fish from one stock. It's going to have fish for the whole series of stocks potentially down the coast.

Salmon from hatcheries dominate the runs and the lobbies, but the trouble is that the hatchery fish are not analogous to the wild stocks that are mandated to be recovered. And while hatchery fish may have some characteristics that make them less vulnerable to dredging impacts, wild stocks probably represent those that are more vulnerable.

And the other thing is that this isn't just a situation now of the laws and the regulations that Doug put up in that sort of circle diagram with all the arrows pointed to it. We now have the equivalent to international treaties. That's the treaties with the Indian tribes that also play a major role in the decision process.

They absolutely have to be at that table. And not only have to be at that table, they represent not only an exploiter, but they represent a cultural and a very strong social attachment to salmon. Maybe even a stronger impetus than the economic.

I don't probably need to go much into this. You know, there's a variety. You could probably use exactly the same diagram for shad or a number of anadromous species. You have issues of acute mortality, with entrainment, dissolved oxygen, sublethal contaminants, the indirect, sort of sublethal delayed mortality effects which again is one of these things that, with resources that are not at risk quite often doesn't enter the equation. Those responsible for protecting the ESA, threatened endangered species, have to look at delayed mortality.

The other thing, which is also seldom considered, is this ecosystem change, the actual effects of the dredging itself in terms of the ultimate configuration of the estuary, and how that might influence long-term fitness of the fish.

The important thing in terms of the salmon vulnerability to dredging plumes is that they're surface oriented, and the fry are restricted to shallow water. So, where any plume impacts or intersects with the shoreline or shoals in shallow water habitats and the surface, they're most vulnerable.

And particularly those that are listed in the Puget Sound, they're more vulnerable to brackish regions where they're undergoing smoltification. They do avoid turbidity. And I think there's a lot of potential information that could be developed that would give us a better understanding of that avoidance response. And they've evolved in terms of ecosystems.

So, it's not like turbidity itself is necessarily an impact. But it really does depend upon the extent of impingement of that migratory corridor and those rearing habitats. But it's very dependent upon the population structure. And so it's sensitive to this sort of landscape context.

I just wanted to point out that again, we talked about the tool box. There's a whole suite of tools and specifications that are used in our region in the state of Washington by the Washington Department of Fish and Wildlife. Timing limitations for environmental windows are just one of those aspects.

But this is the technical basis. This is what the resource agency brings to the table in terms of returning the environmental window. It's based on protecting 90 to 100 percent of the run time, but in broad areas. This is based on data from trapping juveniles as they're moving out into the estuary and actually sampling them in the estuary and the coastal neutral zones.

There are some very broad geographic groupings representing sort of roughly equivalent tiny windows. That could be a lot more definitive, and the data is actually there. It's sort of the nexus between not quite being confident about the applicability of data from one system to another as well as reluctance to get too specific in an administrative code that takes months, if not years to modify.

And as Jerry pointed out, it still quite often comes down to the best professional judgment of the local habitat biologists.

This is sort of what those geographic groupings look like. In other words, 1 through 9 here, I've highlighted 4 because I'll use that as a case study. But this whole group of the Puget Sound along the eastern margin is considered to have the same general stock characteristics.

This group of route canal and the eastern shoreline, Puyallup has another, and then the other, of course, Grays Harbor and Willapa Bay have different ones. So, those sort of form the general stock characteristics.

But, in fact, stocks from the Skagit River and Snoqualmie River, and various watersheds have some very different stock characteristics. This is just a grouping for utility sake. And that in some respects is compromising the flexibility of windows. So right now although this is under modification, that's not the window, but the precluded period of dredging for salmon in Washington State. This is before ESA. And you'll note that there are fairly broad exclusion periods, March 15th through June 14th, March 1 to June 14th in each region, but this is before ESA.

The state is now looking at several options which are much more specific, but as you'll notice are much more constrained.

We're now talking in most cases February 15th, except down here, several places March 1 going at least through July 31st. In some cases, down to September 1. So, all of a sudden that window has shrunk dramatically.

So, what are the alternatives? How do you work and exploit potential flexibility in that process? There are two or three, and I'm going to talk basically about the system specific one. And that is to use location specific, stock specific, estuary specific data to try to adapt the window to the variability in those local populations.

There are also issues of actually monitoring such intensity and scope of the stressors as well as actually real-time monitoring, determining how the fish are responding and adjusting dredging activity at that time.

There's an interesting example that I'm going to use to wrap up, which is the approach that has happened very recently in looking at dredging that has to occur in Commencement Bay. This is where the Puyallup River comes in the Puget Sound. This is the city of Tacoma. This is what it looked like historically. Those of you who have been to Tacoma now know that it's a string of waterways that constitute a Port of Tacoma that occupy the historic type flat in marsh.

These to a large degree are the concentrated areas, super fund sites. And we're now at the position of clean-up Commencement Bay. And so we have now the intersection of ESA and super fund.

That brings another whole suite of people to the table, but it also brings a real desire on the part of EPA and Migratory Fishery Service, and the other parties to try to balance what they perceive to be the impacts of dredging and the ability to clean the system up and contribute to the recovery of specific salmon in this system as well as any other salmon that might use the estuary by removing the contaminated sediments as rapidly and efficiently as possible. So there's the impetus to make this work and be flexible at how to make it work.

And so what's happened is that this decision to try to allow as much dredging as possible to get contaminated sediments out there and do other remediation means that they are now looking at conditioning dredging from this original February 15th to August 15th to now backing off and incorporating some flexibility on the later stage of this prohibition period.

Because the fish that ultimately come out later are potentially more and more of the larger fish that are less and less vulnerable. So the idea is that they have some flexibility they could give up in terms of interpreting the fish's vulnerability to dredging at the later end of the period. And based on this, they now have become more flexible in terms of permitting dredging not only back to July 31st, but also to July 16th.

So, when there's a real impetus to deter fish and remove other stressors such as contaminated sediment for long-term recovery, the flexibility becomes much more evident. And so what you really need to do is examine how we can look at each dredging case with this level of flexibility and incorporate that information that Jerry talked about.

So, I'll just finish up with some research graphs. You know, as Jerry said, there's the automatic response, we always need more information. But you can see that the power of this sort of flexible approach on an estuary stock, watershed specific aspect suggest that that level of information really offers some potential to take it case by case or estuary by estuary and allowing and modifying windows to both protect the species, but also to accommodate the variability that exist in those population structures.

There's also a need, as Doug pointed out, to really understand better the behavioral responses to not only dredging, but also noise and other near field influences, and to better understand how fish respond to that across that ecoscape or the estuary.

And the individual population significance of nonlethal responses is something that again is shown on the table with very little data and very little information. That's another aspect that really needs to be pursued, the extent of mixing a population in receiving waters. With the ESA we now have the ability to know much more about the sources of fish that are mixing in zones from different estuaries, different watersheds. So, that information is gradually accumulated.

And really the issue of contaminant exposure and delay and sublethal injury is one that's always going to be on the table until we gather more information about that. Thank you.